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Global Climate Change and the Unique (?) Challenges Posed by the Transportation Sector

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Climate change, what's the ultimate goal?

The ultimate objective of this [The Framework] Convention…is…the…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Three Key Elements:

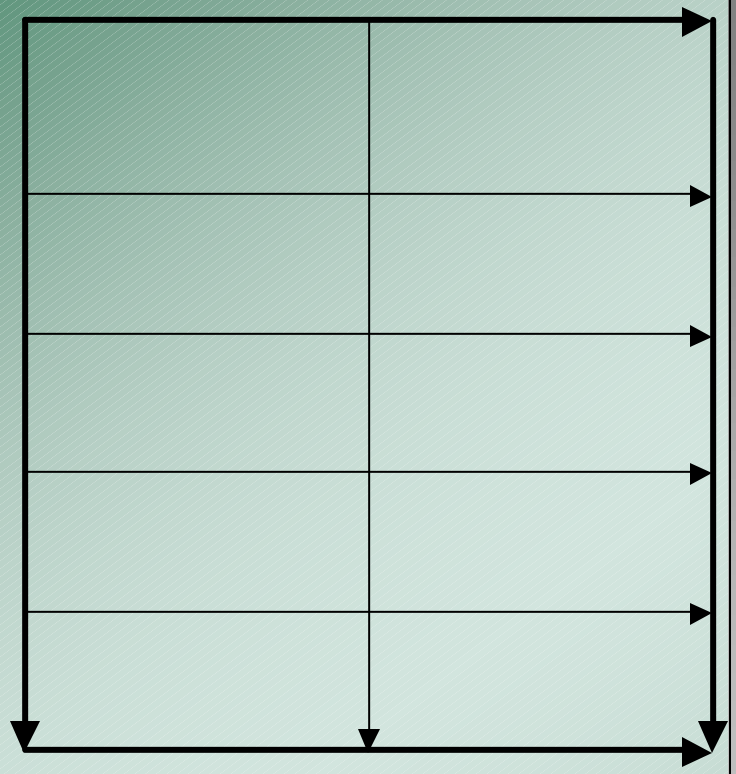
Stabilizing concentrations <u>not</u> emission levels

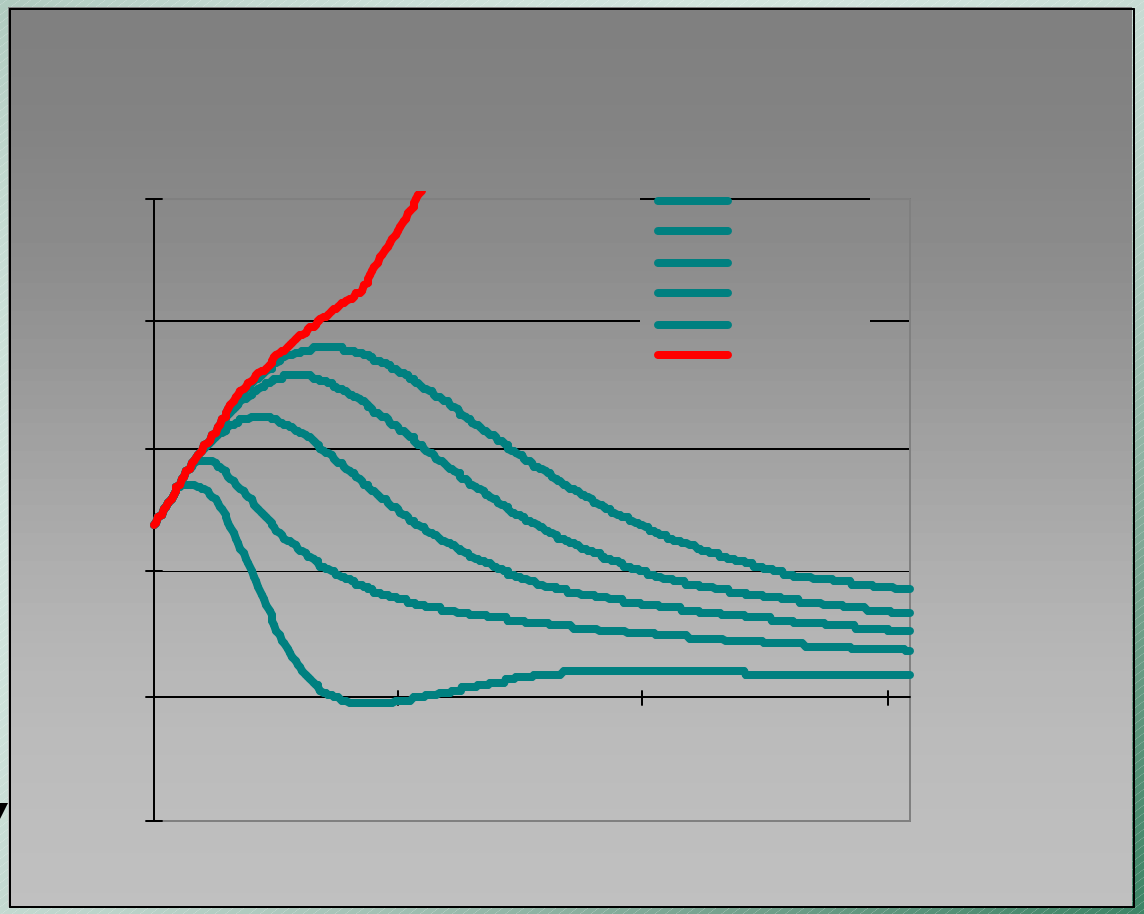
Prevent danger at some <u>unspecified</u> level

Allow economic development to proceed

The Challenge…

Inherent in Stabilizing Concentrations





The Challenge is to manage this "carbon budget" wisely.

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The Challenge …

How to Craft Technology and Policy in Three Different Time Frames

- *ould be as little as 10 years or up to 30 years*
- *20 to 60 Years*
- *—50 to 150 Years*

Emissions on path to zero.

O
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a

Learn, learn, learn about possible solutions.

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-
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AND

Slow global growth in emissions.

offset.

already peaked.

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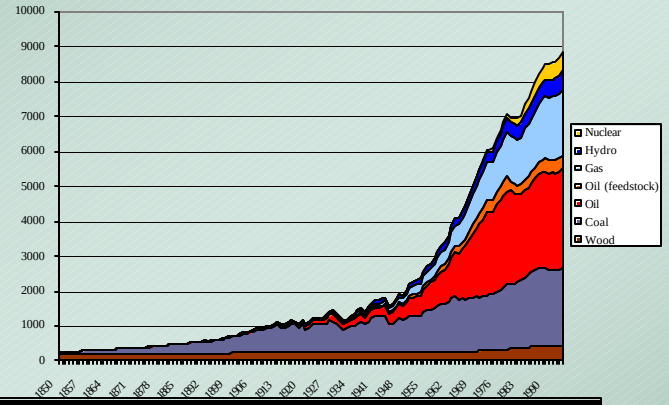
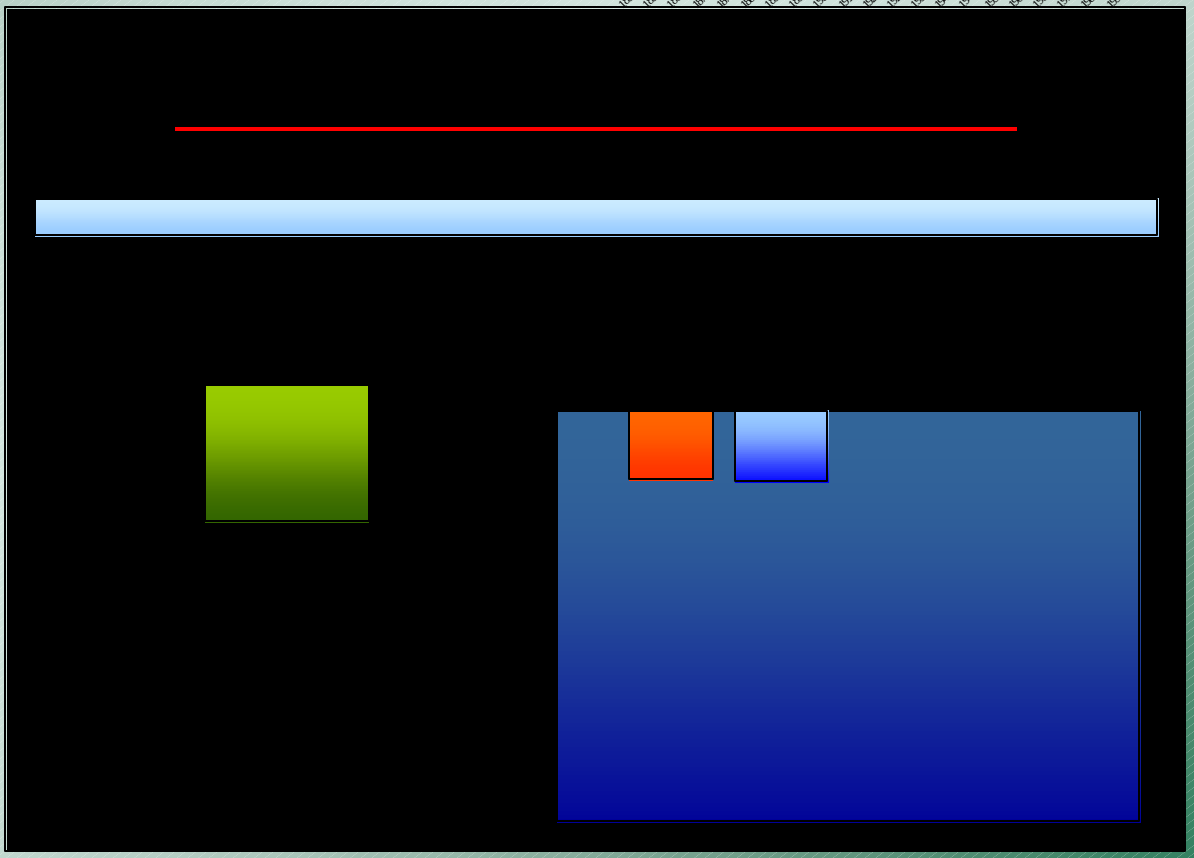
The Problem

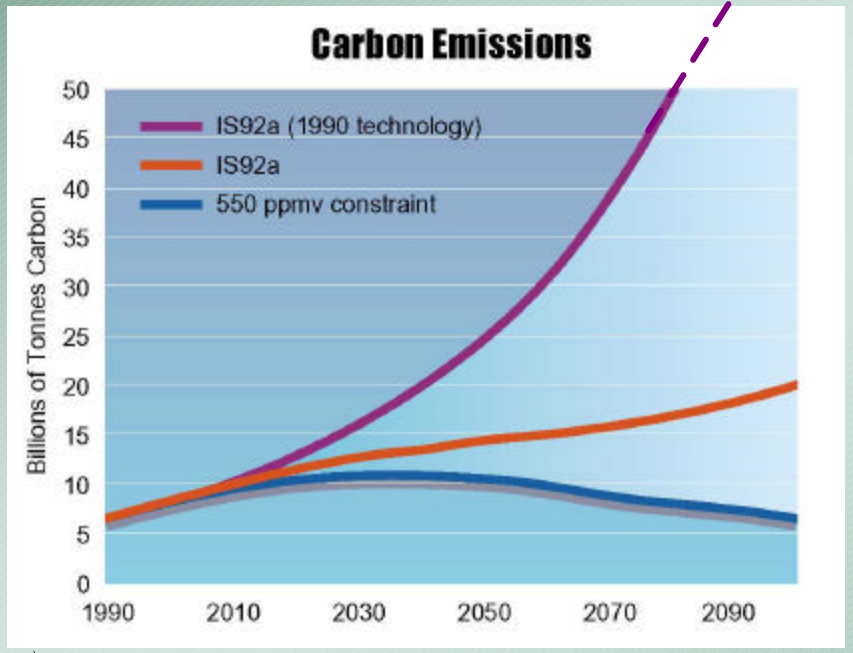
Stabilization Requires Fundamental Change in The Energy System





The Problem

Population and economic growth will generate increased demands for energy services.



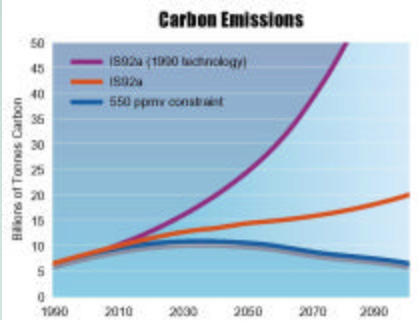
Where today's technology will take us

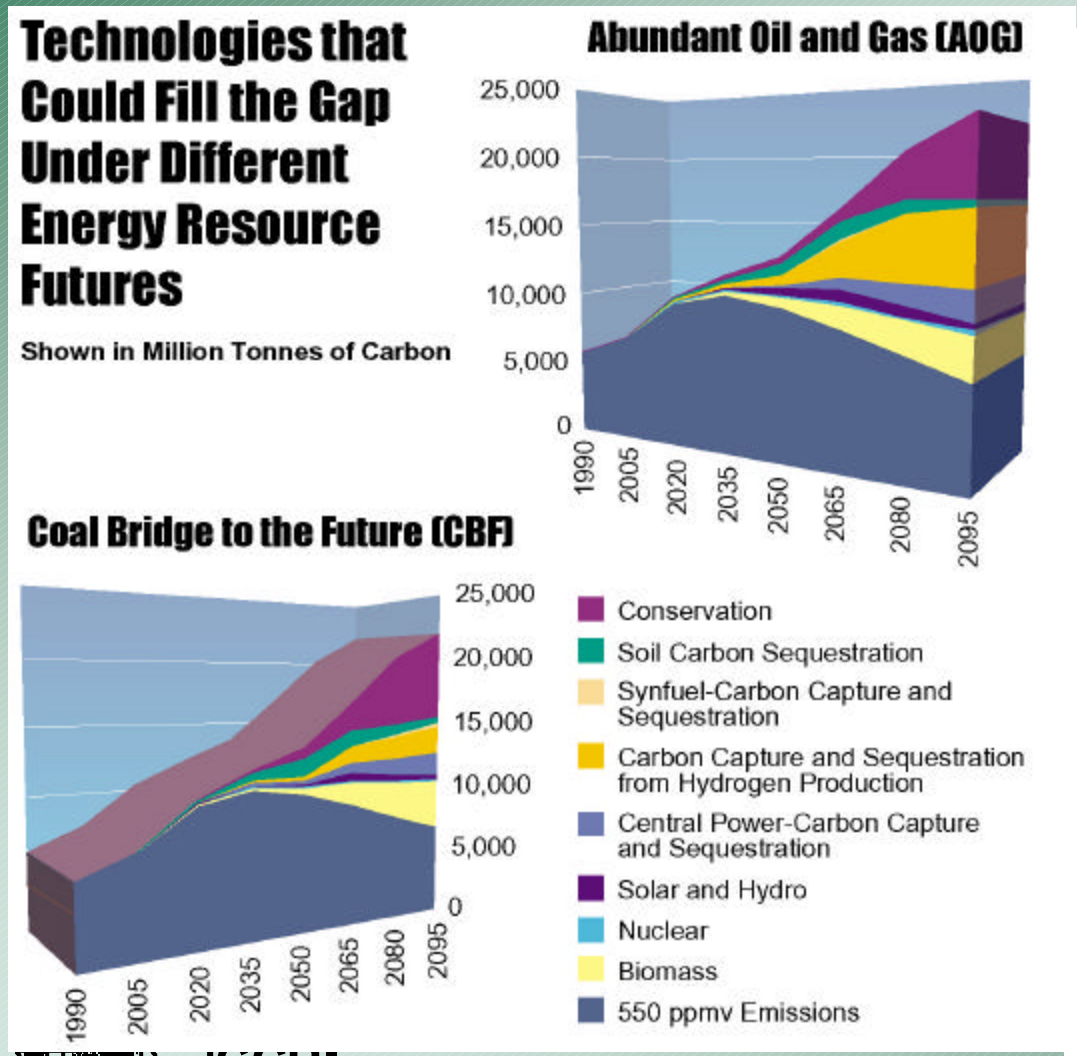
Where more advanced versions of current technologies will take us

Path we need to be on to stabilize carbon at 550ppm

The Solution: Close the Gap (s)

Getting from "business as usual" to stabilization at 550 ppm





Technologies that could make a big difference in closing the gap are not significant aspects of the current global energy system:

at any point in the energy system

production, transportation & distribution

Key Points from the Climate Primer

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-
- _____

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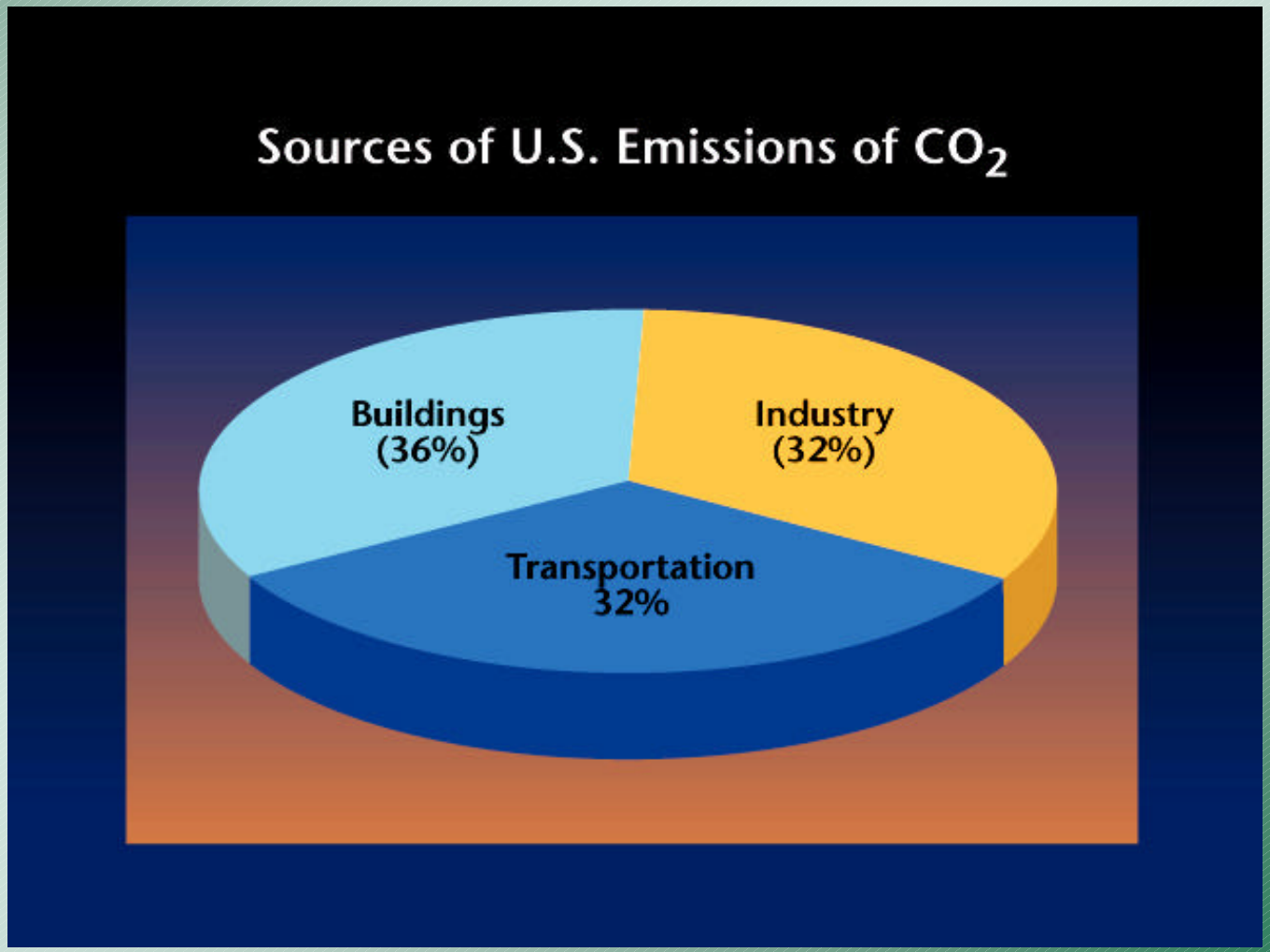
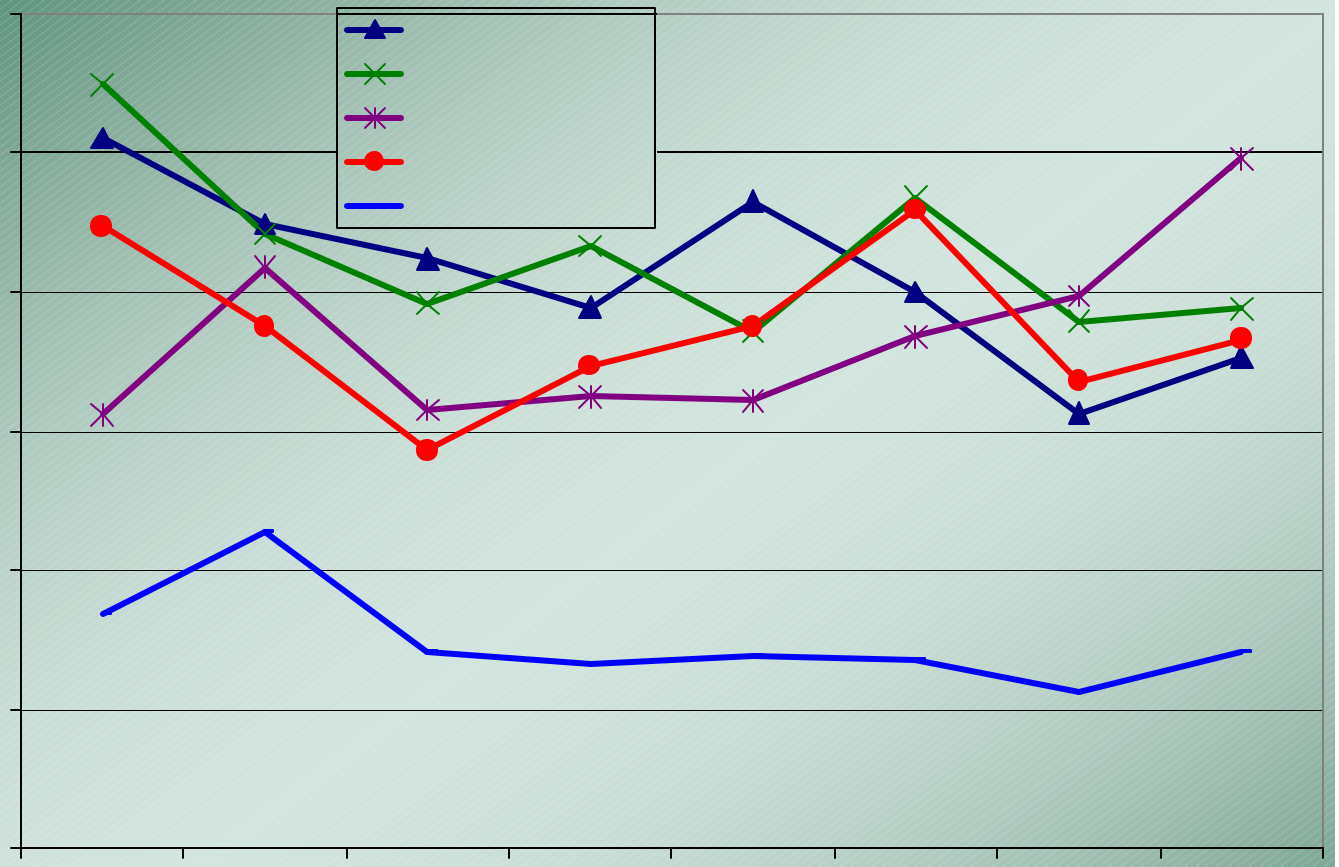
The Transportation Sector
A Large (but often overlooked) Component of CO_2 Emissions



The Transportation Sector

Carbon Taxes Are Likely to Have a Modest Impact on the Transportation Sector's Absolute GHG Emissions

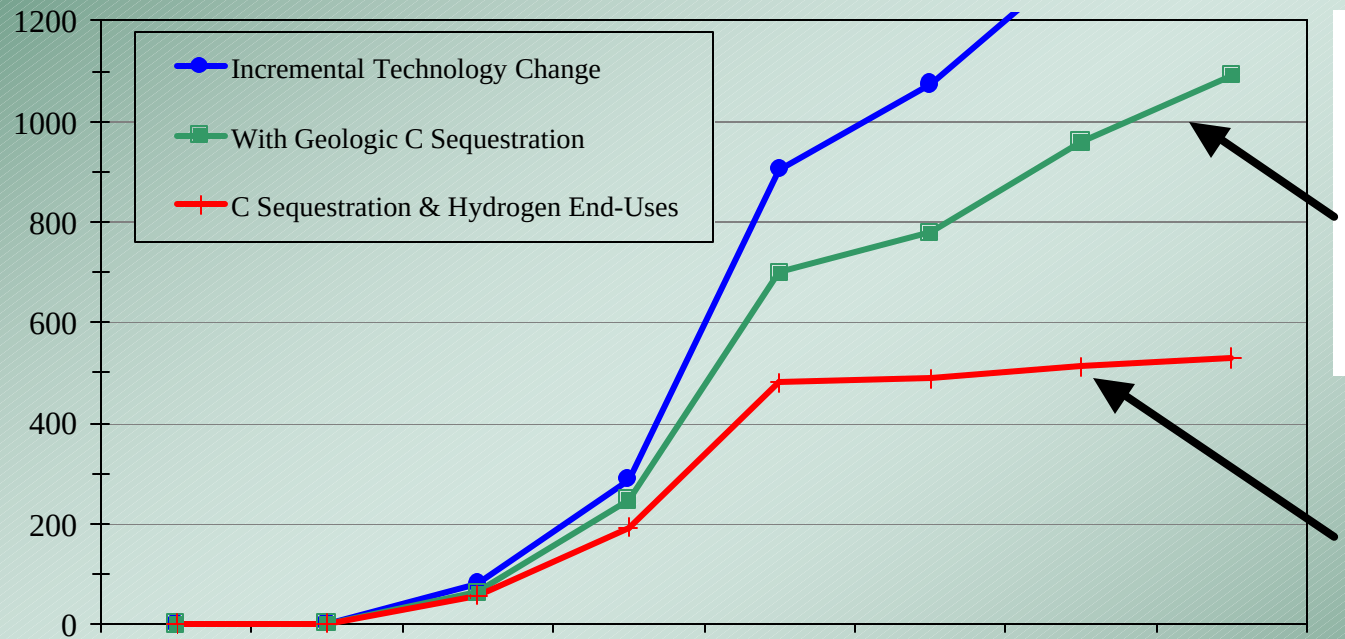


That's the equivalent of a sustained carbon tax differential of $600 to $1400 ton C.

A carbon tax at that level would drive fundamental change in the electric utility sector.

The Transportation Sector

The Ability to Decarbonize the Transportation Sector May Hold the Key to Economically Addressing Climate Change



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The Transportation Sector

Transportation without emissions, which system(s)?

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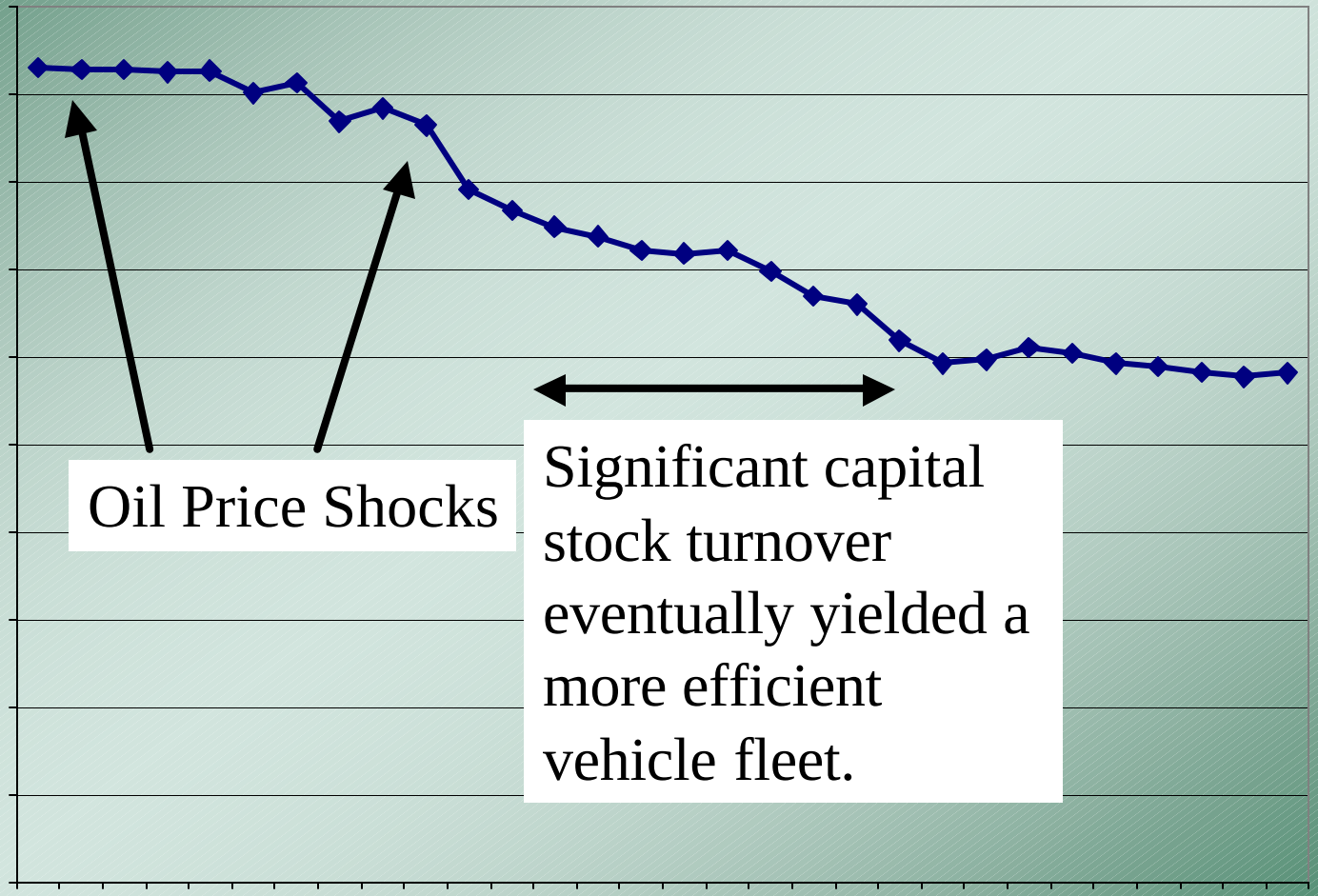
The Transportation Sector

A Thought Experiment: How Do We Transition to a Zero or Near-Zero Global Transportation Sector?



The Transportation Sector

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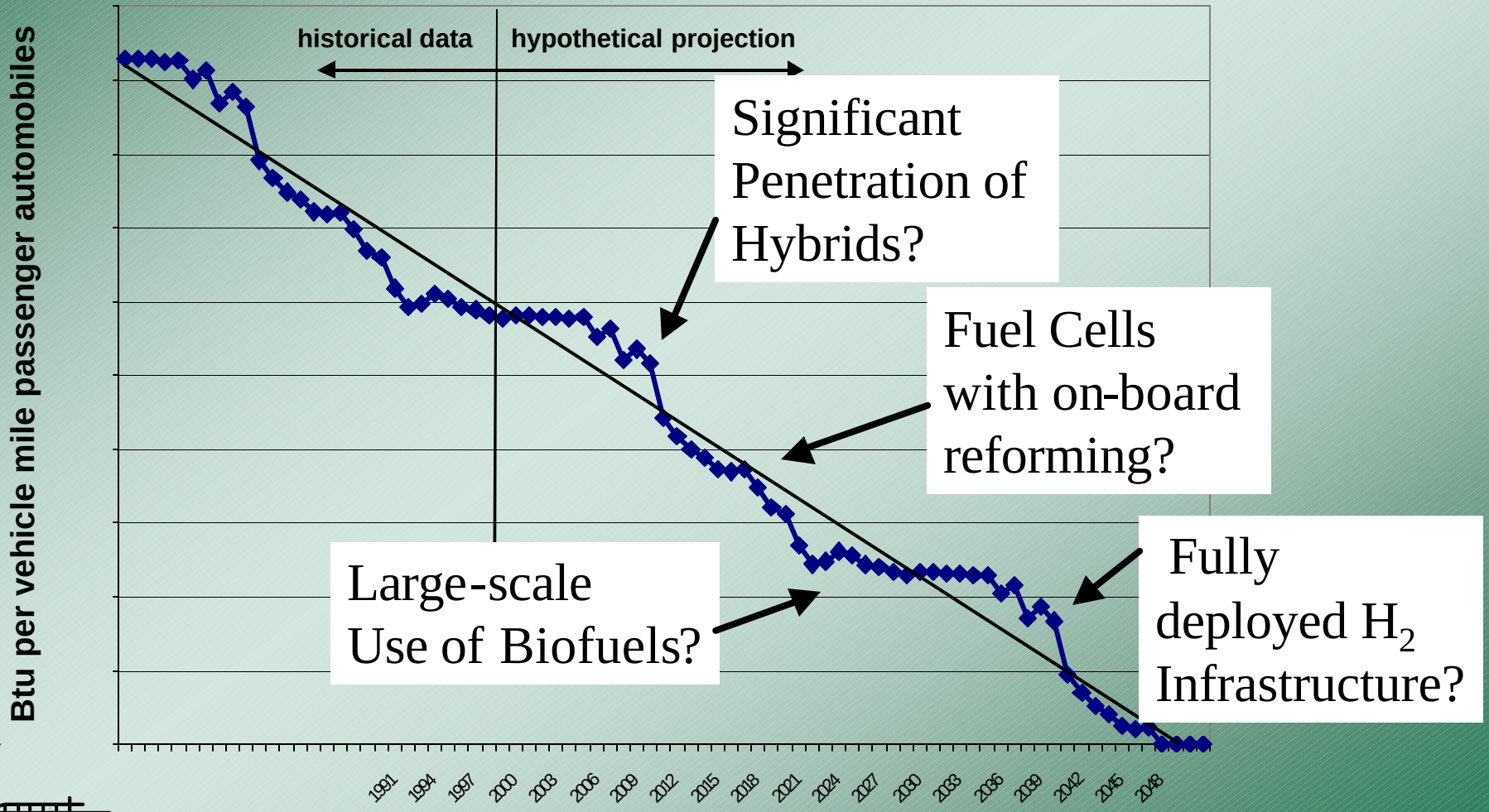


The Transportation Sector
Key Summary Points

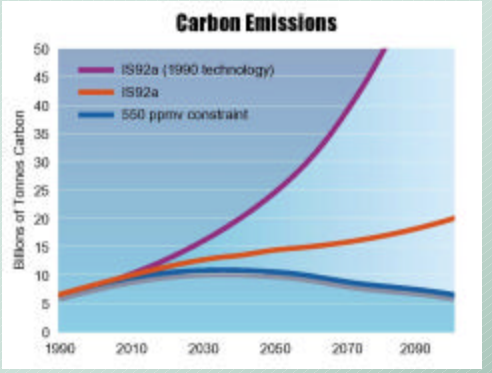
- Other sectors of the economy will likely "go first" in reducing their GHG emissions, but this will not last forever.
- The use of carbon taxes will likely be much more effective in other sectors of the economy in stimulating a move to low carbon or no carbon energy systems.
- Decarbonizing the transportation sector will likely be "technology-led" rather than a "price-led." Technologies need to be ready before they are needed.
- Climate change transportation technology solutions need to be globally deployable.

The Transportation Sector
Key Summary Points

- There are many possible routes to a zero emitting transportation sector, but how many of these can survive simultaneously in the global marketplace?
- Where does the decarbonization of transportation systems take place -- on board the vehicle, at the corner gas station, at the city gate, at a regional refinery, …?
- How do we incentivize "zero emission transportation R&D"? Who gets to decide who the winner is?

"Addressing climate change" is only one of many transportation needs that must be met simultaneously.

A Technology-Based Strategy For Addressing Climate Change Is Desperately Needed



- **Goal is Stabilizing Concentrations**
- **Century-Scale Problem**
- **International Problem: Need Global Solutions**
- **We Need a Comprehensive and Enduring Strategy**
  - *Mitigation*
  - *Technology Development that Supports a Portfolio of Energy Technologies*
  - *Climate Adaptation Research*
  - *Research to Resolve the Remaining Scientific Uncertainty*
- **This paradigm will allow us to reduce the cost of addressing climate change by trillions of dollars and likely facilitates the attainment of other societal goals such as energy security.**